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Effects of Age and Media Packaging on Designing Training Systems
Evaluation of Advanced Automated Geospatial Tools

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FROM THE DIRECTOR

Welcome to this edition of the MSIAC Journal. Increasingly, individuals, groups and communities across DoD are looking to M&S to improve their functions and business processes. Some organizations are expanding their investments in new and emerging technology. Some are developing innovative applications for M&S, while others are trying to understand the "whys and wherefores" of M&S. All have a common approach: they are seeking solutions and exploring possibilities through the "lens of M&S."

This issue of the MSIAC Journal examines these three separate viewpoints: M&S technology development, M&S application, and the understanding of M&S fundamentals. George Mason University's Volgenau School of Information Technology and Engineering presents an approach to and the results of experiments examining how best to utilize automated geospatial tools. The article by the Proteus Management Group explores applying gaming technology to examine the volatility, uncertainty, complexity, and ambiguities of evolving warfare techniques. The paper by Mr. Randy Koons of Alion Science and Technology demonstrates how media packaging and our chronological age affects the utility of training systems and their development.

I hope that you enjoy reading this selection of articles and papers on different viewpoints through the "lens of M&S."

Dane Mullenix, MSIAC Director

Evaluation of Advanced Automated Geospatial Tools

Center of Excellence in C4I
The Volgenau School of Information Technology and Engineering
George Mason University

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Abstract

Geospatial reasoning has been an essential aspect of military planning since the invention of cartography. Although maps have always been a focal point for developing Situational Awareness, the dawning era of Network Centric Operations brings the promise of unprecedented battlefield advantage due to improved geospatial situational awareness. Automated Geospatial Tools (AGTs) are ubiquitous within current military forces and also civil and humanitarian organizations. Nevertheless, there is too little empirical evidence to quantify the military value of automated geospatial tools to the warfighter. As research and development efforts progress to bring forth the next generation of AGTs, Advanced Automated Geospatial Tools (AAGT), it is vital to inform the development process with sound empirical assessments of the military value of AAGTs within a Network Centric Environment. To this end, the U.S. Army Topographic Engineering Center (TEC) is sponsoring a series of experiments to evaluate the value of its AAGT, the Battlespace Terrain Reasoning and Awareness Battle Command (BTRA-BC) Tool. This paper discusses the scope of the current experiment, the hypotheses we intend to investigate, and the experimental design. Results of our first set of experiments will be provided at the conference and in a later version of the paper.

1. Overview

The focal point of the battlefield command post is the map. Through interactions with the map, the commander and staff collaborate to build a common operating picture. This common operating picture displays the area of operations, the militarily significant features of the terrain, the locations of adversary friendly forces and neutral, and the evolving plan. A generation ago, planning centered on a paper map, its overlays of acetate covered with marks of grease pencils wielded by the staff members congregated around it. Today the paper map has been replaced in brigade and larger headquarters with a digitized map projected onto a large-screen display. The grease pencil has become a mouse that officers use to draw objects or select pre-computed overlays from a pull-down menu of options. The map and overlays are stored in the computer as data structures, are processed by algorithms that can generate in seconds products it would take soldiers many hours of tedious effort to duplicate, and can be sent instantly to relevant consumers anywhere on the Global Information Grid (GIG).

Advanced automated geospatial tools (AAGTs) transform commercial geographic information systems (GIS) into useful military services for Network Centric Operations. Because of their basis in commercial GIS, they have widespread applicability to fire, police, disaster relief, and other problems characterized by a command hierarchy. The advanced situation awareness provided by AAGTs can do much more than simply speed up calculations. They are changing the way military operations are conducted. The development of tools is shaped by military necessity, but the decision making process itself is being shaped by the automated tools that provide warfighters with more robust situational awareness.

This reality of 21st Century Command and Control places a major responsibility on researchers who develop tools to support soldiers as they perform their duties. It is essential that we accurately assess the value of the tools we develop with respect to planning processes and situation awareness. These assessments can then be used to shape future research and development efforts.

Intense research and development efforts are underway in many organizations, funded by different agencies, with the goal of moving the state of the art forward and pushing the latest generation of AAGTs into the field to meet the current urgent need. A rapid development and procurement process is needed if we are to provide warfighters with tools that provide force multipliers and save lives.

Research indicates that sound methodolgies for assessing the value of decision support tools for task performance, coupled with effective development processes that make use of the feedback thus obtained, can dramatically improve the effectiveness of decision support (Adelman, 1992; Boehm, et al., 1984; Hicks and Hartson, 1993).

This paper describes a project underway at the U.S. Army Engineer Research and Development Center to evaluate the value added to military decision making

through the use of AAGTs. The specific AAGT to be evaluated is the suite of Battlespace Terrain Reasoning and Awareness Battle Command (BTRA-BC) Tools (U.S. Army, 2003). The BTRA-BC components build upon a commercial GIS tool (ArcInfo). The BTRA-BC tools create information and knowledge products that empower soldiers with information to enhance their understanding of terrain and weather as it impacts their functional responsibilities. Participants performed terrain analysis using the Army's Digital Topographic Support System (DTSS) both with and without the enhanced capabilities provided by BTRA-BC. DTSS is a fielded system that provides topographic engineering support to terrain and topographic technicians as they assist military planners (Herrmann, 2002). DTSS provides geospatial data generation, collection, management, information processing and services. The BTRA-BC capabilities evaluated in this study include identification of obstacles, production of a modified Combined Obstacles Overlay (MCOO), and generation of mobility corridors. Our experiments will provide essential information to evaluate the contribution of the BTRA-BC tools in particular, and AAGTs in general, to enhance the military decision making process.

The paper is organized as follows. Section 2 describes the overall scope of our research program and the scope of our initial set of experiments. Section 3 discusses the primary and secondary hypotheses which will be examined. Section 4 lays out the design of the experiments and the reasoning which led to this design. Section 5 discusses the computing environment which will be used in the experiments. Section 6 describes the metrics used to allow us to quantify the results of each trial. Sections 7 and 8 present the proposed statistical analysis and a brief discussion of the importance of evaluation during development.

2. Scope of Experiments

Our ultimate objective is to evaluate the benefit to commanders at the brigade level and below of combining a fully developed AAGT with currently available Command and Control planning tools. The scope was limited in the first experiment, and will expand successively in later experiments. The experiment with which this paper is concerned is limited to the Intelligence Preparation of the Battlefield (IPB), specifically the terrain analysis portion of IPB.

The baseline for this series of experiments is the currently fielded DTSS suite of tools, as implemented using ArcGIS 9.1. The DTSS tool suite consists of a package of software tools used to generate tactical decision aids for producing off-road and on-road speed products; combined obstacle overlays (COOs); shaded time distance; masked/visible areas for observation; and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach.

The AAGT under evaluation is the Battlespace Terrain Reasoning and Awareness Battle Command (BTRA-BC) Tool. Our first experiment evaluates the most current version of BTRA-BC. When fully developed, it will consist of six information generation components and five decision tools addressing terrain effects. Each of these components utilizes terrain feature data, digital elevation models, and information about tactics, techniques and system performance. BTRA-BC information generating components produce information addressing: (1) observation, cover and concealment, obstacles and mobility, key terrain and avenues of approach (OCOKA), (2) integrated products defining operational positions of advantage, (3) advanced mobility analysis, (4) digital ground and air maneuver potential and (5) tactical structures relating information produced by the other components. Decision tools support: (1) predictive multi-criteria, multi-objective maneuver, and logistical route analysis for ground platforms and forces, (2) predictive sensor performance (e.g., infrared [IR], millimeter-wave [MMW], seismic, and acoustic), (3) situation assessment and (4) predictive threat assessment

BTRA-BC research, development, products and architectural approach are designed to empower the Joint and Future Force's Battle Command, and Intelligence, Surveillance, and Reconnaissance (ISR) processes and systems in a networked force structure through the incorporation of actionable terrain and weather information and tools. The BTRA-BC approach is wholly consistent with the Army's Future Combat System's (FCS's) System of Systems and the Defense Information Systems Agency's (DISA) Network Centric Enterprise Services concepts. If successful, BTRA-BC will be capable of benefiting the FCS C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance) appliqué and the Joint Distributed Common Ground Station family of ISR systems.

3. Hypotheses

In order to evaluate the "value" of BTRA-BC, we needed to establish what constitutes "value" with respect to military decision making. Discussions with both military operational planners and members of the BTRA-BC development team clarified the areas where AAGTs in general and BTRA-BC in particular would be valuable to the military decision maker. The first and most obvious inherent value of an AAGT is in its ability to reduce the

time spent generating a given tactical decision product. Since the timeframe available to military decision makers is limited, the reduced time in which AAGTs require to produce the desired output can free up time for a more through analysis of the large amount of data available. This more complete analysis is expected to result in a higher quality output which will be of more value to the decision maker.

The second value contribution of an AAGT is its automation. Many of the initial tasks traditionally done by terrain analysts with paper maps are sufficiently rote in nature that an AAGT, given digital information and the appropriate parameters, can perform these functions more quickly and with less error than a human. The concern that automating these tasks will reduce the analyst's familiarity with the terrain and understanding of the impact on the military planning may be valid, but the experts we consulted believe that the automated tasks are procedural and not analytical and that using the output of the AAGT will not compromise the analysis of the data or the level of understanding of the analyst. The experiment was designed to test this prediction.

It follows from the discussion above that the primary hypotheses to be tested in the initial evaluation are the following: In comparison with analysts using currently available tools, we hypothesize that trained and experienced terrain technicians who use BTRA-BC will:

1. Produce certain terrain-dependent Intelligence Preparation of the Battlefield outputs *more quickly*. Rationale: The automation in BTRA-BC should allow the subjects to complete the repetitive, tedious, and rote tasks more quickly.
2. Produce a *higher quality* output. Rationale: The automation in BTRA-BC should minimize errors of omission and in calculation and standardize the graphical representation of impor tant terrain features.
3. Display *as good an understanding* of the impact of the given terrain on military decision making. Rationale: The judgment required to complete the required tasks will still be required when using BTRA-BC.

The secondary hypotheses to be investigated became apparent as the determination of "value" and the design of the experiment evolved. The automation of some tasks which were previously performed manually, which adds value to using an AAGT, will likely reduce the variation in the output. As this reduction in variation does not necessarily add value, this was not considered a primary hypothesis. The structure of the experiments requires the repetition of various tasks and there was concern that a learning effect might skew the results of the experiment. The consensus of experts in terrain analysis indicated that this would be a very minor effect and as such learning effects are considered secondary hypotheses. The secondary hypotheses to be investigated include:

1. The output generated with BTRA-BC will be *more uniform,* i.e., have less variance in the first two of the three categories above (speed and quality), than that generated without the use of BTRA-BC. Less variation in the output when using BTRA-BC is expected due to the level of automation incorporated in BTRA-BC.
2. There will not be a *learning effect due to the subjects gaining experience with the C2 planning tools* during the first trial. The subjects have previous training and extensive experience using the C2 planning environment used in the experiment. The tasks the subjects are asked to perform are those that they normally perform with the C2 planning tools. A single additional usage will not be evidenced as a learning effect.
3. There will be *little or no learning effect due to the repetition of the tasks* required in each trial as the subjects have performed similar tasks numerous times prior to the evaluation.
4. There will be *little or no learning effect on the subjects' cognitive process due to using BTRA-BC in the first trial.* BTRA-BC automates processes with which the subjects are extremely familiar and will provide no additional insight into these processes.

4. Study Design

The general study design will remain consistent throughout the series of experiments and will employ a within subjects design. A within subjects design is one in which each subject performs both sets of tasks. A within subjects design is particularly valuable when the number of available subjects is limited, as in the current case. In addition, the results from the sets of tasks can be compared for each subject thus eliminating subject specific effects that might skew or add variability to the results. The within subjects design is superior to the between subjects design (subjects only perform one task) especially if there are no learning effects.

The participants performed the same tasks on two similar military planning scenarios, where one of the tasks is performed with BTRA-BC functions in addition to DTSS functions and the other task with DTSS functions only. The two trials are essentially identical except

for the use of BTRA-BC in addition to currently deployed geospatial tools. The order of the tasks was randomly selected so that half of the subjects perform each of the tasks first. Randomizing the order of the tasks enables the analysis to control for learning effects.

The instructions, tasks, requested outputs, and evaluation of these outputs were the same in both trials with the exception of geographic references necessitated by the requirement to have different geographic areas for each trial. Different geographic areas are required to prevent participants from just repeating their responses from the first trial when they form responses for the second trial. The two areas were carefully selected for their geographic similarity such that the tasks performed by the participants and the expected results were as nearly identical as possible.

The participants, Army non-commissioned officers trained as terrain technicians, were split into four groups that are evenly balanced as to the experience of the participants. Two of these groups performed the tasks first without BTRA-BC and then with BTRA-BC. The other two groups reversed the order of the use of BTRA-BC. Within each of these pairs of groups, the two groups differed on which scenario was used on the first day and which on the second day. This design allows the analysis to control for any variance in results due to the experience of the subjects and the order of the sets of tasks or the experience level of the participants.

The tasks consisted of that portion of the IPB beginning with analyzing the specific terrain given a Combined Obstacle Overlay (COO) up to the point of generating potential Avenues of Approach (AA). Specific tasks included:

1. Identify Mobility Corridors (MC)
2. Categorize mobility corridors by type of force
3. Group mobility corridors to form potential AAs
4. Identify choke points on potential AAs

The participants produced a graphic overlay depicting (1) all Mobility Corridors (MC), (2) four potential AAs, (3) Choke Points on potential AAs, (4) recommended AA, and (5) recommended 2nd echelon Areas of Operations (AOO).

Prior to beginning the tasks, both groups of participants received standardized training on the use of BTRA-BC and the DTSS planning tools to be used in the experiment. The training was sufficient to perform the required tasks given the subjects' level of experience with automated systems and included training on the modes and features unique to BTRA-BC. The last phase of the training required the participants to perform tasks based on the training and similar to those that the subjects would encounter during the trials, but of lesser complexity.

5. Environment

The evaluation was conducted using the Digital Topographic Support System (DTSS) as the baseline technology. DTSS can be categorized as an Automated Geospatial tool (AGT) as opposed to a next generation AAGT, such as the BTRA-BC tool we are evaluating. DTSS is the currently fielded set of geospatial tools used to support the IPB. Modules of the BTRA-BC are compatible with DTSS and were embedded in the version of DTSS used in this experiment. During the trials in which the subjects are using BTRA-BC, the BTRA-BC modules were enabled. During the trials in which the subjects do not use BTRA-BC, these modules were disabled. DTSS was chosen specifically because it is the current state of the art in AGTs, it is currently fielded, and the potential subjects are familiar with its use.

6. Metrics

Because trials were conducted in DTSS, it may be possible to do blind scoring for some of the hypotheses. The criteria for evaluation of the BTRA-BC will be (1) a comparison of the rapidity with which the requested outputs can be produced, (2) the quality of those outputs, and (3) the level of understanding of the participants of the impact of the terrain on the military decision making.

The evaluation of how quickly the desired outputs are produced can be measured objectively independently of the experimental condition by logging the amount of time it takes participants to finish the task. Thus, blindness is not an issue for the speed measure.

The evaluation of the quality of the outputs may be affected by the evaluator's ability to distinguish between BTRA-BC outputs and non-BTRA-BC outputs. If the outputs are distinguishable as to their source, then the evaluation of quality can not be treated as blind. We use two measures of quality of output: the first consists of objective metrics such as the number and validity of mobility corridors and choke points, and is relatively independent of whether blind scoring is achievable. The second part of the evaluation of quality, which is still in progress, will be a subjective evaluation by impartial experts. The evaluators will judge the quality of the output with respect to the usefulness to the commander. Criteria to guide the evaluators are under development. Evaluators will provide numerical ratings of quality of output,

according to the criteria provided to them.

To evaluate the subjects' understanding of the impact of the specific terrain on military decision making, we administered a questionnaire. The answers to the questions were not outputs of DTSS or BTRA-BC. The answers required judgment and reasoning about the terrain and its effect on the military decision making not just regurgitating data presented by DTSS or BTRA-BC. Topics included in the questionnaire included justification for recommended AAs, key terrain features, cover and concealment, an potential locations for support bases. A rubric for grading the questionnaire responses is under development.

The assessment of the second and third primary hypotheses and the secondary hypotheses was augmented by the recorded comments of observers. A statistical analysis will be conducted to test each of these hypotheses, and the combined results will determine the evaluation of the value-added of BTRA-BC versus the currently fielded system.

7. Analyses of Results

The first of the experiments has been completed. Results from the first round of experiments will be published in a later version of this paper and will be presented later. Analysis of variance will be performed to provide quantitative estimates of the degree of statistical support for (or against) the hypotheses.

8. Discussion

Evaluation of complex systems should start in the development phase as well as continuing through the procurement process. Evaluation started early in the development process allows developers to choose design options with the greatest potential value as well as identifying specific problem within the design. It is well known that problems found early in the design and development process can be addressed with orders of magnitude less impact on cost than if they are not identified until a later stage. Additionally, evaluation results may provide insights into possible system design enhancements not previously identified. A key factor in providing the best possible feedback to the designers is to perform evaluation with subjects who are actual users. This is often somewhat difficult to achieve in the research setting, but true "value" can only be determined by those who actually use the system.

A properly designed evaluation program can build upon initial results to conduct follow-on evaluations at each step in the design process. Once the value of the system at any point is determined, the resulting follow-on evaluations can be easily combined with previous results to form a coherent overall evaluation. The ultimate goal of the design and procurement process is the fielding of the most "valuable" system to the military decision maker.

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Effects of Age and Media Packaging on Designing Training Systems

Alion Science and Technology

By: W. Randall Koons

Abstract

In today's work place there are four distinct generations working side-by-side. Generational differences can be expressed in terms of visual media exposure. There are often disconnects between the Baby-boomers and the "Nintendo" generations. Training programs designed for learners under thirty, are often conceived and funded by decision-makers who are over fifty. During their formative years, these two groups had very different media exposure that shaped their expectations for the packaging of training systems. This paper will explore and contrast generational differences that result from exposure to media packaging when each group was under twenty; and how this influences the design, packaging, and funding of training programs today. For the under-thirty learners, exposure to an expanded array of media options has evolved a more visual and kinesthetic learning style. Understanding these changes and utilizing techniques from the advertising domain should improve the effectiveness of current and future training programs. Blending modeling and simulation with packaging and delivery techniques used in advertising and entertainment may result in the cost-effective creation of more compelling and engaging training, reducing learning time, while increasing comprehension and retention. Developing a better understanding of these generational differences is key in the design and funding of training systems.

Introduction

Effective teachers connect with—engage—students and create a more conducive learning environment, while making the material more easily understood. Test scores may vary for the same material presented by different teachers or delivery mechanisms, which infers that *how* well the learner is *engaged* may impact the ability to absorb and recall the subject material.

This paper suggests that widely different expectations about what's engaging are affected by generational differences and exposure to media packaging. Design and deployment of effective training systems must acknowledge these influences to effectively engage the target learner. Advertising creativity and media packaging exert a powerful influence on the learner generation, which may not be fully understood by older generations. Meeting learner expectations—shaped by media—is possible through the use of cost-effective modeling and simulation (M&S) technologies. Packaging training with familiar and effective media techniques will better engage learners and improve results.

Advertising Creativity

Advertising-style creativity can address the issue of subjective expectations. There's a link between training and advertising. They share three common elements: competition for attention, conveying a message, and expected results. Applying advertising creativity may increase the success of a training system. Advertising, media, and entertainment creativity have influenced expectations of anyone who watches TV or movies. Often subconscious, this influence results from carefully packaged media designed to achieve maximum results. Advertising employs academic analysis and focus groups to improve techniques and the effectiveness of the business.

In advertising theory creativity has two primary determinants: *divergence* and *relevance*. Divergence is something new, imaginative, different, or unique. A divergent product—advertisement—must fulfill a need or have relevance to the target audience. Effectiveness is the measure of how well the product achieves its intended purpose, which is dependent on social recognition criteria—context. An ad may be creative to one group (e.g., senior citizens) and not to another (e.g., teenagers) (Smith & Xiaojing, 2004). Therefore, creativity misapplied to the wrong audience will likely reduce the effectiveness of the intended effort and result in fewer sales of the advertised product.

These determinants can be directly applied to a training program. Divergence is used as the hook to engage and capture audience attention, making them more receptive to the message. Relevance maintains their attention—following the entire message—and will likely increase retention. Effectiveness is measured by test scores and improved practical application of the acquired knowledge.

Understanding the contextual determinant of the target audience's age will improve divergence, relevance, and effectiveness.

Generational Cohorts

Workplace age-range is between 18 and 65. In 2005 this spanned four distinct generational cohorts. A generational—birth—cohort is "the aggregation of individuals (within some population definition) who experience the same event within the same time interval" (Ryder, 1959). Studies define some cohort classifications based on significant historic events, such as the Depression and landing on the moon. Of considerable importance is when a cohort "comes of age"—early adulthood at ~20 years old. Generally, people are most attached to memories and experiences from their early adulthood. Personal experiences such as films, television, games, and advertising tend to influence people well into their adulthood (Schewe & Carlson, 2003) (Kramer, 2004).

Life experience affects perceptions and expectations, while influencing what is considered divergent and relevant; and each generation's expectations are quite diverse. Table 1 shows an overview of context and the attributes of the four generational cohorts in the 2005 workplace. This workplace configuration is slowly evolving as WWII and Boomer cohorts retire.

Media Cohorts

This paper will address the influence of visual media along with the techniques and technology that deliver it. Figure 1 shows Birth Cohort social context and what media affected the different ages. Figure 1 demonstrates the relationship between age, media, and technology. This figure can be used to determine a person's age and what media and technology was available to them at different ages during their lives. Television, movies, videogames, personal computers, and other technology have created another set of *media* cohorts. A selective list of media and technology events (y-axis) has been arranged by the year in which they occurred. Along the x-axis is year and age related information. The Year row is an absolute scale, against which ages and events are mapped. Birth Cohort section shows a person's age in 2005, which can be read by matching age with the year row above. If you were 50-years old in 2005, you were born in 1955. Formative Years section maps your age in 2005 to the years when you were 5- and 20-years old. If you were 50 in 2005 you were five in 1960 and 20 in 1975. Training Participants shows three relative work roles in 2005: Sponsor, Designer, and Learner. Age and Year scales will provide mappings to media and technology events. The cohort boundaries become apparent in Figure 1 as three Media cohorts emerge: Pre-Sesame Street, Sesame Street, and Nintendo & PC.

Children's Television Workshop (CTW) developed Sesame Street to teach preschool children letters, numbers, and basic reading skills. CTW's design was based on the developmental characteristics of their target audience. CTW research (Alexander, 2004) (Gibson, 2004) determined that short exciting segments of information—colorful animated visuals—capture and hold the child's attention. This method successfully improved the audience's basic letter and number skills. In fact, Sesame Street reinforces short attention span, which has far-reaching consequences.

Using the Formative Years scale in Figure 1, it can be seen that Sesame Street had practically no influence on anyone over 40. Reading and associated concentration along with fewer media choices are the influences on the *Pre-Sesame Street* cohort. The innovative technique of packaging instructional and other television media define the *Sesame Street* cohort boundary. It began a transformation of media packaging that accelerated the pace of information packaging. *Nintendo* is the next significant media boundary. Nintendo and the PC heralded the era of interactive entertainment. Sesame Street is television, a passive activity. The Nintendo cohort actively participates in the choice, delivery, and outcome of their media experience.

The Training Participants section in Figure 1 shows three classifications of roles. *Sponsors* are generally between 50- and 60-years old. As decision-makers they determine how and what projects will be funded. *Designers*—generally between 30- and 50-years old—assess learning objectives, analyze user requirements, and develop training systems. This role includes Instructional System Designers and Subject Matter Experts (SME). *Learners*—typically between 18- and 30-years old—are the end-users of training systems.

In 2005 sponsors and designers over forty belong to the Pre-Sesame Street cohort and primarily map to the Boomers. Designers under forty belong to the Sesame Street cohort and mainly map to Gen-X. Learners are clearly from the Sesame Street and Nintendo cohorts and map to the Gen-X and Millennial cohorts. This is a transitory situation that will change in 20-years when few sponsors of the Pre-Sesame Street cohort will be working.

The relationship between age, work responsibility, and media provides a context to better understand the influence of media. However, it's important to consider

Cohort	WWII	Boomer	Generation-X	Millennial
Year Born	1922-1943	1943-1969	1969-1980	1980-2000
Description[1]	•Rise of Middle class, expected prosperous times to continue indefinitely	•Viet Nam, Civil Rights, Watergate, oil embargo, less optimistic about financial future	•Free agents not team players, spirit of entrepreneurship	•More idealistic, social-cause oriented
Coming of Age Historic Events ~20 years old[1]	•Post WWII, Korean conflict	•Turmoil of the 1960s and first sustained economic downturn since the Great Depression	•Latchkey children of divorce, cultural diversity	•Information revolution, Internet
Coming of Age Media ~20 years old	•Radio, B&W television, color television	•Star Trek, cable television, VHS VCR	•MTV, Nintendo, Windows PC, Internet, Jurassic Park	•DVD, Broadband Internet, Instant Messenger
Learning Style Preferences[2]	•Traditional classroom, stable, organized, risk-free	•Interactive and non-authoritarian, relationship building	•Self directed, learn-by- doing themselves	•Teamwork, technology, task oriented

Table 1. Historical Generational Cohorts

cohort expectations as trends and not absolutes. Based on domain experience and exposure, some sponsors and designers are well aware of learner media exposure and expectations. Cohort *generalizations* are presented in this paper to set context for this subject.

The Influence of Media

Sponsors control funding of training systems designed for learners. Sponsors and older designers have significantly different experiences and expectations than learners. Anecdotal data suggests considerable differences between these groups regarding effective and engaging training. This disconnect may be due to formative-years media exposure. Sponsors grew up before the explosion of media and communications technology. Learners typically don't remember a time before DVD, cable TV, videogames, and computers.

A sponsor, who was 55 in 2005, was 20-years old in 1970 and their media exposure had been primarily limited to radio and television; and TV commercials were typically one-minute long. The Pre-Sesame Street cohort achieved management positions based on traditional learning styles and methods from public school and university educations.

After 1970—the Sesame Street boundary—the media world changed rapidly. Figure 1 shows an accelerated expansion of media and technology options. Within twenty years the increased pace resulted in the PC and Nintendo. The post Sesame Street cohort's formative years had more media options utilizing increased pace and production value, which shaped their expectations.

Most people will agree the pace of life has increased and continues to accelerate. Figure 1 shows the jump in media and technology options and a dramatic change in TV advertising. The Sesame Street model demonstrated that short, fast-paced media packaging was very effective. The advertising industry adopted similar tactics and increased the use of the 30-second spot—commercial. Some twelve years later came 15-second spots, and by 2003, 5-second spots began to appear. In little over 30-years, one-minute of TV air time went from presenting a single message to the possibility of four to twelve *different* messages.

Not only have commercials grown shorter, but the number of edits per spot—distinct changes in the visual continuity—has increased. The author conducted research on this aspect by downloading 295 TV commercials from various Internet sources. These commercials covered a period from 1947 to 2005, and ranged between 2-minutes and 15-seconds in duration. This is by no means intended to be an exhaustive study of commercials, but to provide a large enough sample to demonstrate trends. Table 2 uses 161 30-second spots from this collection. The number of edits was determined by viewing and counting the total number of edits per spot. Duration of edits was calculated by dividing the average number of edits into the spot length of 30-seconds.

From the first sample period to the last, an average of 5.7 edits per spot has jumped to 20.2; and the average number of seconds per edit went from 5.29 to 1.48. The reversal of this trend in the 70's may be due to the

Effects of Age and Media Packaging cont.

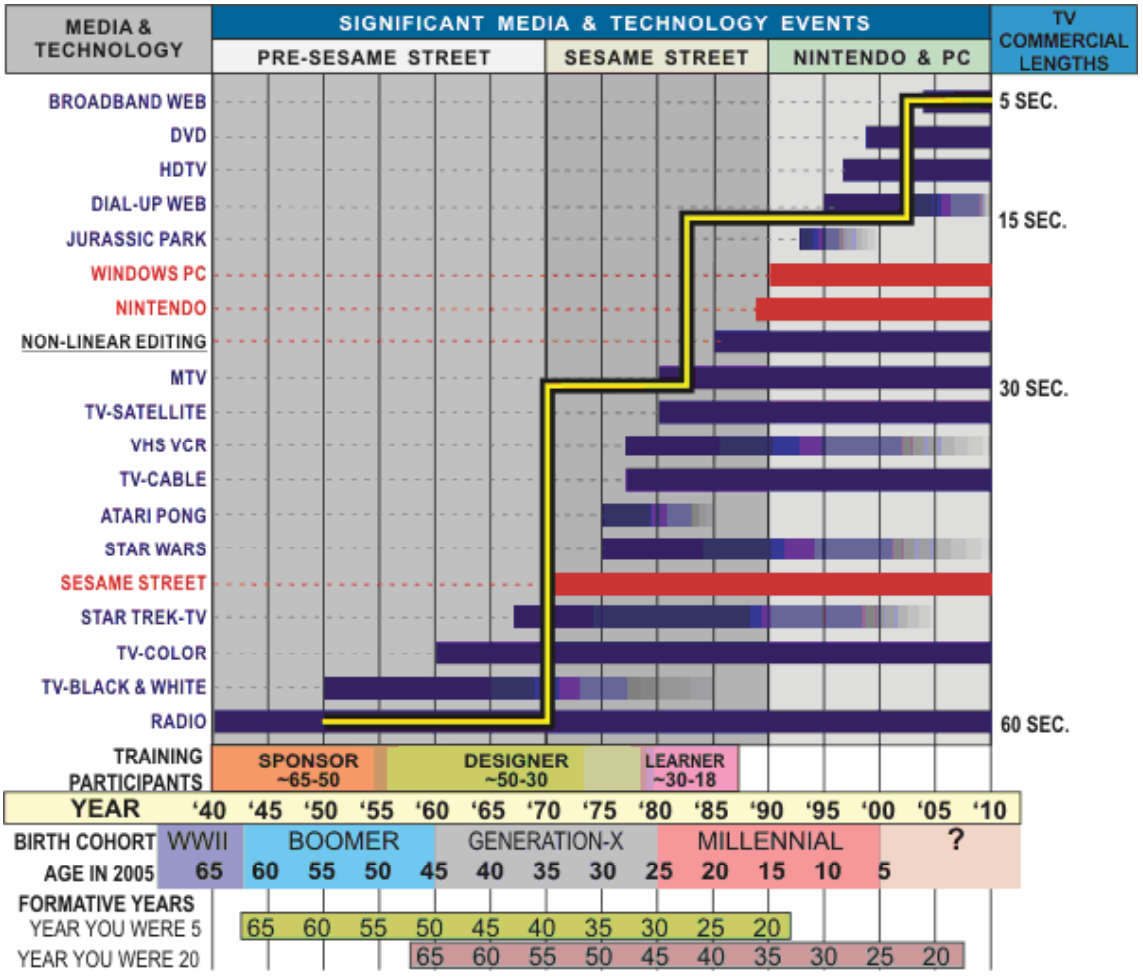

Figure 1. Media and Technology Events Mapped to Generational Cohorts

limited number of samples, or the cost of editing in pre-digital video was growing too expensive per edit.

Period	Samples	Avg. # of Edits	Avg. Sec./Edit
'47-'59	6	5.7	5.29
'60-'69	29	12.2	2.46
'70-'79	15	9.7	3.08
'80-'98	14	16.9	1.77
'01-'05	97	20.2	1.48

Table 2. 30 sec. spot average edits and edit duration

However, the overall trend shows that the Pre-Sesame Street cohort was exposed an average edit length of 3.88 seconds compared with a 1.63 seconds for the learner cohort; presenting more information to absorb in a shorter period. Table 3 shows how ads targeting children—formative years—have the fastest pace. Sponsors grew up with significantly slower media pacing than learners. These averages were derived from the entire sampling regardless of spot length

Period	Avg. edit/sec. Adults	Avg. edit/sec. Children
'47-'59	7.84	3.80
'60-'69	4.30	4.09
'70-'79	8.18	2.50
'80-'98	1.65	2.29
'01-'05	2.08	1.57

Table 3. Adults va.children media pacing

The dramatic increase since the 80's is not simply stylistic, but a result of digital video non-linear editing introduced in the mid 80's. Word processors increased productivity for text documents and non-linear editing transformed the video post-production industry. This revolution enabled editors to assemble commercials and

programs in less time, in an environment that charges editing by the hour.

In 1950 "Lazy-Bones" was the first available TV remote control. In 2000, more than 99 percent of all TVs and 100 percent of all VCRs and DVD players sold in the United States are equipped with remote control (Zenith). When a viewer watches TV, they can react to boring content—does not engage—with the touch of a button and begin channel surfing for content that will engage the viewer to stop surfing. The remote has forced advertisers to apply the Sesame Street formula and create exciting, fast-paced content to reduce boredom. It must be fast enough to engage a surfing viewer who spends only seconds per channel. However, it's not just increased pacing that is required to grab attention, but also an increase in production value.

The advertising and motion picture industries use production value to apply relative quality standards for mass media delivered products. Production value can be understood by comparing science fiction film special effects over the past 60-years. In the 50's, audiences accepted spaceships on wires with rumbling exhaust plumes that ignored zero-Gs in the vacuum of space. At the time, that was considered acceptable production value, but not in 2005. "Star Wars Episode III: Revenge of the Sith" (2005) blurred the distinction between reality and effect—despite rocket engines still making noise in space. However, the visual quality differences between these examples demonstrate the concept of increased production value.

Advertisers and filmmakers understand the necessity of production value. "The ultimate judge of production value is the *target* audience. If you keep them interested in your film, it's a sign of good production value. If they come back for your next film, you are on the right track." (Bitar, 2003). The same is true of TV programs and commercials, videogames, and…training. Learners, exposed to an increased level of production value and pacing has increased their expectations of computer-based training (CBT), which is considered as another media experience. Audiences *expect* fast-paced, high production value media. Advertisers and filmmakers know this and spend accordingly on TV programs and commercials, and videogames. Table 4 shows the increased investment for the Star Wars movies due to competition for audience dollars and attention. The values in the 2005 $ column are adjusted for inflation by Original $/Factor.

Technology has affected the media production industry with greater use of digital effects. Hollywood films now costs an average of $60-million, doubled since 1996 (Kelleher, 2004). More effects increase production values, which further raise audience expectations. Media production facilities take this seriously enough that technology improvement is like an arms race. "With technology squeezing upgrade cycles, you have to keep buying to stay alive," says Adi Kishore, a Yankee Group entertainment analyst (Kelleher, 2004).

Movie Title	Yr.	Original $ [A]	Factor [B]	2005 $
Star Wars	1977	$12.5	.310	$40.3
Empire Strikes Back	1980	$25	.422	$59.2
Return of the Jedi	1983	$32.5	.510	$63.7
Phantom Menace	1999	$115	.853	$134.8
Attack of the Clones	2002	$130	.921	$141.1
Revenge of the Sith	2005	$115	1.00	$115

Table 4. Star Wars production costs in millions

Teenagers are watching fewer hours of TV! Harris Interactive and Teenage Research Unlimited polled over 2,500 teens and young adults (ages 13-24) and results show a weekly average of 16.7 hours are spent online—excluding email—and 13.6 hours watching TV. The primary reason cited for this trend: the ability to control, personalize, and manage their media experience and content (Silicon Valley/San Jose Business Journal, 2003). The use of PCs, videogames, and personalizing music selections with MP3 players delivers far more control of media options. The expectation of control through interactivity is another powerful force to reckon with when designing effective training systems.

Learning Styles

In 1983 Dr. Howard Gardner, professor of education at Harvard University, developed the theory of multiple intelligences (MI) (Armstrong, 2000). MI postulates there are eight different learning styles: linguistic, logical-mathematical, visual-spatial, musical, interpersonal, intrapersonal, naturalist, and bodily-kinesthetic. Traditional classroom education has focused primarily on the linguistic and logical-mathematical. Learners from the Gen-X and Millennial cohorts—Table 1—have unique learning style preferences and worldviews; they prefer visual and kinesthetic learning styles. Like all students, they learn more effectively when taught in accordance with their learning style preferences and when their worldviews are

acknowledge. Multitasking is an attribute of the learners. "If people are really good at processing information from lots of different sources and you don't give it to them, you stifle them," says Marc Prensky—CEO and Founder Games2Train (Harmon, 1998). Learn-by-doing is an effective tool for training the learners, as it takes into account their learning style. Learners have been exposed to far more high production value, fast-paced, interactive, and visually-based content than the sponsor cohort.

Know Your Target Audience

Advertising, motion pictures, TV, and videogame producers are keenly aware that successful products are designed for the target audience. They understand the need for divergence and relevance; pacing and production value; and they plan and invest accordingly to achieve their goal: profit. Training system design should be no different, but it is. "Death by PowerPoint" is a common term associated with training. The comment shouts out boring! "Up until this generation, learning has been associated with pain, but that's changing because a new generation doesn't accept it. They don't buy the fact that fun and work have to be different." (Prensky, 2000) For learners, fun is often associated with computers and fast-paced videogames (Meyer, 1998).

Age, media influence, and learning styles have an undeniable influence on personal experience and expectations. Understanding the overall effects of mass market media packaging must be considered when developing new training systems. What works for one generation may not work for another. When faced with funding decisions, sponsors may wonder why the concept of "fun" should have anything to do with training, dismissing concepts that appear to be fun as a waste of money. The Pre-Sesame cohort's formative years were shaped by traditional education, which focused on the linguistic and logical-mathematical learning styles. Multimedia in the classroom was either a filmstrip or a 16mm film projector.

Sponsors may ask, "What's wrong with the younger generation?" Learners just have different experiences, preferences, and learning styles. These differences must be recognized as assets that should be cultivated through proper training, which connects with the learner for improved training, comprehension, and retention. Yet the generational differences between sponsors, designers, and learners may prevent the development of successful training systems. Arguably, the primary success-metric of training systems is cost/benefit. Improved productivity equals profitability and safety equals reduced expense. These are two expected results from training. Withholding proper investment in learner appropriate training may save money in the short-term, but reduced or inefficient training may result in lower productivity, decreased safety, and a net long-term loss.

Entertain, Engage, and Educate (E3)

If training design is to benefit from applying techniques from advertising theory, consider applying E3. Entertain is the first E, and perhaps for some, the hardest element to reconcile with training. To entertain during training is not intrinsically negative. Entertain is defined as: hold the attention, engage or engross wholly. Provide an initial dose of divergent entertainment, with the possibility of more during the training experience, may serve to capture and hold the attention of a multitasker and improve retention. Advertisers and CTW craft products to achieve success by using this method.

Entertainment yields the second E: Engage. Allowing learners to interact with training systems further reinforces engagement. Linear page turning through a PowerPoint slide show is minimally more interactive than a book. The Internet and videogames have ceded control and interactivity to the learners. Employing learn-by-doing and the visual-spatial and kinesthetic learning styles will likely improve the capacity for engaging the learner.

Education—the third E—takes place when the learner is fully engaged in the material. Education becomes an easier task with interactive and visually-rich content. This should amplify the powerful learning advantages of CBT as found by IBM and DoD studies showing that all trainees retain 60% of material when taught by CBT systems vs. 15% in standard classrooms (Garry, 1996).

Attempts have been made to improve PowerPoint-based courses by adding video clips. Perhaps adding any sort of dynamic element to PowerPoint may be an improvement. That must be the logic behind using some of the many effects to reveal text. But these are typically the efforts of the designer's own experiences with training in their formative years. It is in fact, a significant improvement on the filmstrip, but the learners see right through these attempts. Flying text and dubious quality video clips are hardly entertaining to the Nintendo generation; no E3 here. If high production value media and videogames are the experience of the learners, forcing them to train with PowerPoint will yield less than optimal results. If the goal is a productive and safe workforce, it will be more quickly achieved by providing familiar venues. However, a balance must be maintained between the needs of the learner and the reality of training budgets.

While learners may be technically and media savvy, they

generally lack the experience to understand the massive investment to produce a videogame that costs them fifty-dollars. This breeds impatience when they have direct experience with an inexpensive product and can't understand why their training product is not more like the game. The typical look-and-feel of videogames is a dynamic, interactive, graphical representation of real-world environments. Training deployed in this format is familiar and readily accepted by the learners. Planning and designing training systems in this venue should yield effective E3 systems. Given the alternatives of linear PowerPoint vs. real-time interactive graphics, learners will naturally gravitate towards what is familiar to their experience and expectations.

The sponsor's experience with interactive graphics may date back to earlier days of simulation when developing and deploying simulators were very expensive. Some may argue that interactive media with high production value is not practical. Based on production costs of films and videogames, they may conclude that high production value training systems are cost prohibitive. This is not necessarily so, as M&S technology may provide an equitable cost/benefit solution.

Conclusions

Developing effective training systems requires understanding the experience and expectations of the target audience. Sponsors and designers have different experiences and expectations shaped in part by a different pace and quality of media exposure. There is a danger of mapping personal experience onto another group who doesn't share the same experience. The advertising and motion picture industry understands how important it is to match product development with the target audience. To do anything less reduces the odds of success and jeopardizes the investment in product development. If the object of training is to improve the productivity and safety of the workforce, that goal is based on cost/benefit. Investment in training is not altruistic, but profit motivated: reduce expenses and increase profit. Investment in training systems that are based on the experience and expectations of sponsors and designers will lack the divergence and relevancy to effectively engage the learner audience.

The Pre-Sesame Street cohorts grew up at a time with fewer options and media was slower and less sophisticated. For them learning was often a painful chore and they had no control over the limited media venue. This is almost the opposite of the learner experience. The pace and production value of media that the learners have grown up with encourages multitasking and interactivity. Training systems that reflect the experience of the sponsors and designers will fall woefully short of learner expectations and reduce the effectiveness of the system.

Production value and interactivity come with a price. Any proposed alternative to PowerPoint training must be cost competitive. Learners weaned on $50 videogames with excellent interactivity and high production value are generally unaware of the multimillion-dollar development costs. Despite learner expectations fueled by media exposure, it doesn't mean training systems will totally match their expectations. Nor can sponsors and designers cite high production costs of videogames and media, and keep feeding increasingly sophisticated learners boring PowerPoint training. A workable compromise must be established between the expectations of the learners and the cost constraints of the sponsors.

The advertising and motion picture industries don't leave success to chance. Target audience focus groups view TV commercial concepts and prerelease ads to ensure the intended message will be divergent, relevant, and effective. Motion pictures are often prescreened to selective audiences to ensure expectations are met and promote success. The design of training systems could benefit from these techniques. Sponsors and designers can't ignore different learning styles and believe that entertaining and engaging content is frivolous or too expensive. Designing systems that reflect the learning styles and expectations of the sponsor and designer is not the way to build effective training systems for learners. Reduce the divergence and relevance of the system and reduce effectiveness; and jeopardize investments made in training systems.

The Way Forward

The first step is recognition that there *is* a difference between sponsors, designers, and learners. Then carefully analyze those differences. Make use of focus groups and seek learner input at the design process; not when the system is deployed. Look to the technologies that are familiar and relevant to the learners. M&S can be used as a cost-effective means of designing and fielding E3 training systems that would likely improve training results. An initial investment in the development of linking simulations with text-based content and learning management systems is a required start. Next, develop the GUIs that will enable SMEs and instructors to easily create and modify content and exercises, which will provide a tremendous cost/benefit and improve the quality of training.

Since all of this must take place in the world of emerging training standards, there is a need to address the potential constraints of SCORM (Sharable Content Object Reference Model) compliant distance learning systems

(DL). The continued extension of SCORM standards that effectively address simulation and the installation of client-side API components are critical to ensure the DL experience will better match learner expectations. WEB-based DL training systems will need to provide much of the experience and benefits learners expect from the WEB.

It's hoped that the information and concepts presented in this paper will promote a better understanding of the impact of age and media packaging. Much of what people experience through media exposure is unconscious. The people behind the designs and techniques have methodically and carefully designed their products to achieve the maximum results with their target audience. The training community needs to make a more conscious effort to utilize these techniques and design for the learner. Make this effort, promote E3 with your audience, and the rewards will be great.

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Protean Media: An Approach to Gaming and Understanding Future Complexity

Proteus Management Group USA

By: Bill Wimbish

The United States Army War College uses the acronym VUCA to characterize the strategic environment in which we must operate. VUCA stands for volatility, uncertainty, complexity and ambiguity. Today's threats target our vulnerabilities and seams, and often employ idiosyncratic methods and asymmetric techniques which, although they are not new in the course of history, are being exploited using new tools by super empowered groups and individuals who hide, adapt, learn and strike quickly and with precision. How do we learned to cope with volatility, uncertainty, complexity and ambiguity in order to holistically analyze our vulnerabilities, identify these threats and determine systemic root causes of national security issues and then apply solutions and develop strategies that can withstand the long term rigors of a complex interconnected world? In other words, do we really understand what it is we want to do and what we do not want to have happen? If we can't repeat patterns and if outcomes based on constant inputs are not constant then how can we anticipate or predict what is on the future horizon?

Understanding the Complexity of Human Terrain

Today, scientists use Complexity and Chaos theory to assist in explaining the properties of complex adaptive systems, relationships and natural phenomena. In complexity theory, behaviors and actions occur in the constantly changing, interdependent interrelationships of evolving systems. The most elusive and complex phenomena are human thought, behavior and the interactive networks within the social and cognitive domains . Often we see the cognitive thought and resultant actions of our adversaries as irrational or illogical. But this may just be a reflection of our own Western biases and they may be quite rational within a different context based on different life experiences, social, cultural and religion norms or ideologies. How do we model or map this form of complexity?

The Proteus Management Group (PMG): Examining Future Complexity

Understanding this area to be a key and critical to understanding and meeting the challenges of a complex future geo-strategic national security environment, in 2005, The National Intelligence University, Office of the Director of National Intelligence established a Futures "think tank", the Proteus Management Group (PMG) to examine areas of future complexity. This organization was spawned by an ad hoc International consortium that based its efforts on a revealing and provocative intelligence project called Proteus. The Proteus project originated as an advanced future concepts research initiative at the U.S. National Reconnaissance Office in 1999. Interim results of the work were published in a book entitled Proteus Insights from 2020. The book contains the original nine "insights" and five "planes of influence" that were derived from examining five "future scenarios."

Today the PMG consists of nearly 300 national and international Fellows and Associates across the many Government, Department of Defense (DoD), intelligence, academic, and business communities who are examining and sharing "Proteus" related strategies and new and emerging processes and methods of analysis and decision-making to meet 21st century U.S. national security needs.

The PMG's charter is to promote further discourse, study and research, focusing on the refinement, development and application of Proteus Insights (PI) and other PI related new and emerging "futures" concepts, methods, processes and scenarios. The group's overall intent is to assist strategic and high-operational level decision makers, planners and analysts in "outside the box" consideration and critical analysis of National, military and intelligence issues within the Joint, Interagency, Intergovernmental and Multinational (JIIM) environment by encouraging them to consider differing values, frame complex issues holistically and scan the horizon to define the future environment in order to identify discreet threats and capitalize on hidden opportunities.

This broad charter has generated a number of initiatives to pursue the group's intent. One of these venues entails examining serious gaming, using a computer assisted Role Playing Simulation (RPS) as a value-added part of the suite of current government and military modeling and simulation (M&S) tools and applications which are

designed to educate and inform analysts, planners and decision makers about future complex adaptive systems; especially in the area of human terrain.

The following discussion will first briefly look at the current and near term M&S efforts in this area and their associated limitations and challenges. Second it will address the potential of serious gaming to enhance these initiatives to better emulate and portray the most elusive and complex phenomena; human thought, behavior and interactive networks within the social and cognitive domains. And third, it will highlight the operational characteristics of the Naval Post Graduate School's and PMG's Protean Media Critical Thinking Game and examine its future potential.

Modeling and Simulation Challenges in the Future Complex Environment

Since 9/11, the beginning of Global War on Terrorism and follow-on combat operations in Iraq and Afghanistan, the U.S. government and military have been rapidly transforming their emphasis from a Cold War doctrine, which focused almost solely on major war; e.g. direct combat operations, kinetic effects and large conventional battles, to new irregular and unrestricted warfare concepts that not only include conventional or kinetic operations but also include operations that addresses the reality and complexity of the human dimension of conflict. Winning the peace and achieving strategic end state will involve a thorough understanding of entity (friend, foe or neutral) belief systems (however rational or irrational), resultant direct and/or indirect actions and the interaction and reaction among these various entities. Within the Operational Net Assessment (ONA) concept, the military has coined a holistic framing convention and acronym, PMESII (Political, Military, Economic, Social Infrastructure, and Information) that outlines the integrated and interrelated systems and domains that are acted upon or are affected through the use of all elements of national power: Diplomatic, Informational, Military and Economic (DIME).

The future challenge for the M&S community as a whole is not developing the algorithms to model or simulate effects of physical military systems; e.g. Probability of Kill (PK), Correlation of Forces and Means (COFM) and other force on force models (FoF). But the real challenge is doing this for psychological effects or human aspects within the complex cognitive and social domains. Although attempts have been made, most current live, virtual, and constructive (L-V-C) simulations developed by the U.S. military to educate and train leaders and staffs have not been able to fully portray or account for cognitive complex adaptive systems where rational or irrational thoughts, ideas and actions abound and relationships are constantly changing and morphing.

For example, most major joint and service oriented simulations used currently to educate intelligence analysts, decision makers and staffs have done a remarkable job at portraying physical or kinetic actions and resultant effects on physical systems of multiple entities within the battle space or theater of war. These include the Joint Forces Command's (USJFCOM) Joint Theater Level Simulation (JTLS), which is a large interactive, computer-assisted simulation that replicates a theater of war and incorporates the Joint Conflict and Tactical Simulation (JCATS) program, an entity-level interactive simulation which simulates operations in urban terrain. Another simulation of this genre is the U.S. Army's Joint Land Component Constructive Training Capability (JLCCTC) federate, which is a federation of current and developing training simulations which stimulate significant asymmetric activity, However, as mentioned, these simulations have not yet reach their full potential in emulating the changing dynamics of political, economic, social and informational actions and resultant effects.

DoD M&S Efforts: A Holistic Look at the Future PMESII Environment

The good news is, that the Department of Defense (DoD) and its multinational partners have continued to move forward to establish greater corporate M&S oversight and community collaborative effort that is providing guidance, coordination and integration of future live, virtual, and constructive (L-V-C) simulations across the military services and Combatant Commands. This ongoing effort transcends simulating and modeling the physical aspect of the operational environment (i.e. effects of weapon systems) and is actively promoting new M&S developments to improve tools for educating, planning, analysis and decision-making that reflect all PMESII effects of DIME actions through a closer examination of agent based modeling.

For example, The Army's Joint Land Component Constructive Training Capability (JLCCTC) federate, which stimulates significant asymmetric activity, is using the newly developed Joint Non-kinetic Effects Model (JNEM) to determine realistic effects of economic, political, religious and social concerns of a given local population through modeling civilian reactions to military action. Similarly, another non kinetic representation, Synthetic Environment for Analysis and Simulation (SEAS), a simulation created by Purdue University and used by JFCOM, simulates an impact or effect on target local

population, entity leadership as well as infrastructure.

The Army's Training and Doctrine Command (TRADOC), in its ongoing futures wargaming and experimentation effort, Unified Quest, also uses a series of simulations and modeling tools within the Integrated Gaming System that focus on emulating the human terrain: beliefs, resultant actions; social networks, direct and indirect relationships between entities and effectiveness of non-kinetic military actions in future complex environments.

The Defense Intelligence Agency has funded a program called Senturion, a predictive, agents based model and analysis tool that simulates the bargaining process on political-military issues. This model profiles stakeholders and their political decision making process. Senturion prioritizes and sequences well-established theories from microeconomics and political theory and uses input from subject matter experts and rule and equation based algorithms that govern stakeholders' political interactions and employs an agent based-game theoretic approach that profiles stakeholders and simulates the political decision making process.

Overall, DOD M&S initiatives are providing analysts, planners and decisions makers with a markedly greater appreciation and understanding of the human aspects of rational and logical actions of the PMESII. However, these tools are still limited in application because they are generally based on linear and deterministic processes versus stochastic and can not fully account for, model or simulate the cognitive domain or human nature and its illogical or irrational or counter-cultural and social beliefs and often unpredictable resultant actions. Being able to account for these actions are especially key in strategic campaign planning or policy planning, since it takes weeks and months for the effects to manifest themselves in many cases. The challenge is to set model conditions to flag and recognize effects, and be able to exploit success in adequate time to react to the window of opportunity. So what additional steps can the government and the military take to gain additional understanding and insight into changing dynamics of relationships and discreet interrelationships within or between complex adaptive human systems in order to prevent unintended consequences or second and third order effects that this form of complexity entails? Serious Gaming agent based applications may add the additional tool to provide the necessary fidelity needed to provide additional insight to this complexity question.

Serious Gaming: Adding Fidelity to Complexity Modeling and Simulation

Adding robust serious gaming using computer simulation and computer assisted RPS to future modeling and simulation efforts that include humans or agents in the loop to act on human beliefs and has the potential to be the next step in providing government and military organizations with the needed capability and fidelity to address and answer these questions. If used properly, serious gaming and RPS can be used as a laboratory to study human complex adaptive systems, especially the psychological, social, and cultural aspects that are needed to more effectively conduct future experimentation, educate leaders and assist intelligence analysts, planners and decision makers in gaining insight and addressing the challenges of the future complex PMESII environment.

Serious gaming, a young concept and capability derived from the multibillion dollar entertainment computer gaming industry, is beginning to gain significant recognition especially in business and academia as a potential strategy and educational tool for addressing future complexity and gaining knowledge and understanding about complex adaptive systems. Serious Gaming Conferences, symposia and programs, like the 2006 Serious Gaming Summit the at the Woodrow Wilson Center's Serious Gaming Initiative are bringing more and more communities together with the gaming industry and developers of games like Full Spectrum Warrior, Civilization III, Linage and SimCity.

These activities are promoting fruitful dialogues and discussions on how to apply serious gaming methodology within the government, military and privates sectors. Games like Breakaway's new Incident Commander, a training program that allows cities to simulate disasters, crises and even terrorist attacks or A Force More Powerful (AFMP), a simulation game that explores the strategy of nonviolent conflicts against dictators, occupiers, colonizers and corrupt regimes and Peacemaker developed by graduate students at Carnegie Mellon University's Entertainment Technology Center that simulates the Mideast conflict and calls upon players to negotiate peace between the Israelis and Palestinians are all examples of games with potential government applications.

Leading research professors in Video Gaming and Learning at The University of Wisconsin's Advanced Distributive Learning Co-Laboratory assert that emulating virtual worlds through gaming is the most powerful learning tool when they are personally meaningful, experiential, social and epistemological at the same time. They further postulate that Gaming lets people participate in new worlds. Players have to think, talk and act simultaneously while

in roles that are usually inaccessible to them. In virtual worlds, participants gain situational understanding by experiencing concrete realities across multiple contexts and can understand complex concepts and gain situational understanding without losing the connection between abstract ideas and real solvable problems.

Serious Gaming and Potential Military Applications

The U.S. military is realizing the potential of serious gaming and is currently using lower level tactical training and recruiting applications such as America's Army. Another project, DARWARS, part of the Defense Advanced Research Project Agency's (DARPA) Training Superiority Program has also examined new kinds of cognitive experiential educational and training methods for units and individuals through advance simulation and gaming. DARPA and JFCOM are actively expanding their search horizon for more operational and strategic military educational and analytical applications of serious gaming to fill the gap in M&S in dealing with complex and often chaotic PMESII environments. These applications would serve to enhance their Integrated Battle Command and Sentient World programs as well. DARPA has specifically stated that "The emphasis in the Integrated Battle Command program is on using extant modeling technologies to develop full scale versions of a set of models that will span the full range of PMESII systems which will model these systems, and the behaviors of humans involved in these systems, and their response to DIME actions, to the extent that they generate comprehensive, authentic predictions and suggestions that will augment the reasoning that a human can perform."

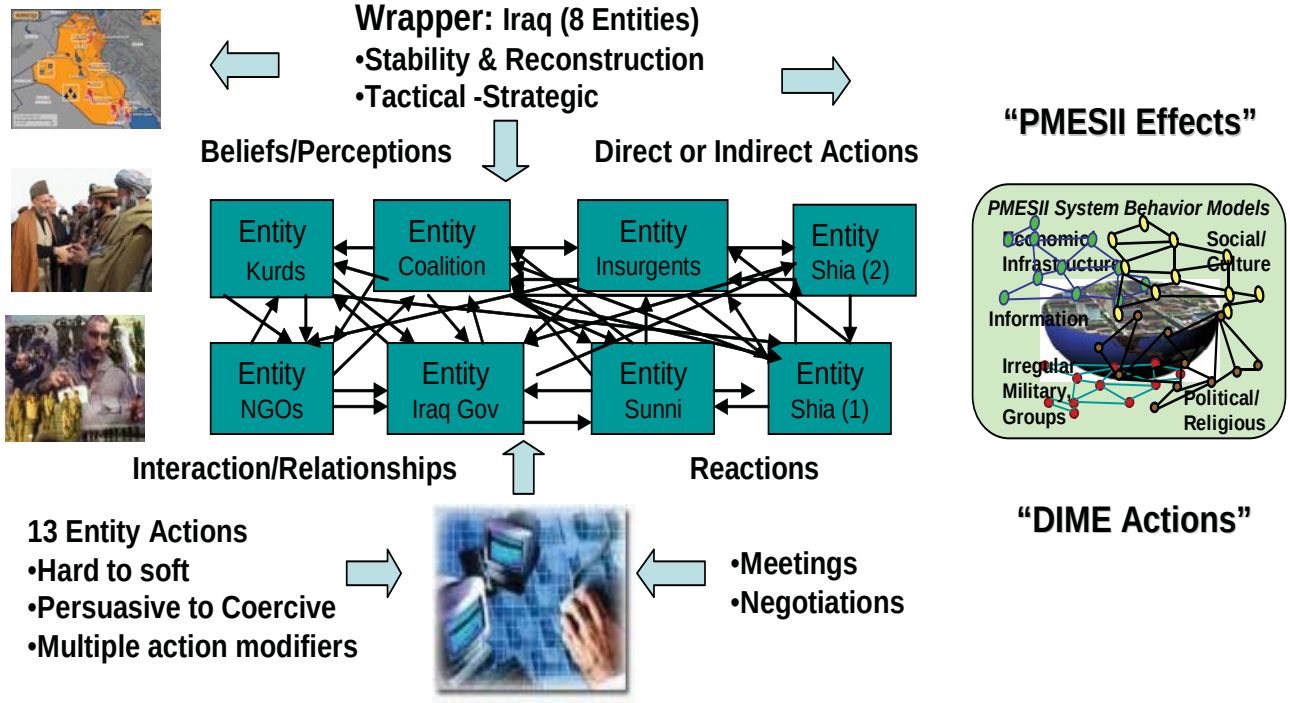
The "Far Future Conflict Game" is another bold initiative to use serious gaming at the operational and strategic level to assist in understanding complex environments. The game is being co-developed by the University of Texas, Dallas and U.S. Army TRADOC. This complex, geo-strategic, multiyear game is designed to assist future analysts and planners to examine future trends and forecasts to determine how conflict occurs, why it occurs, and the specific chain of events that lead to conflict. The game starts in a current virtual world with a wide variety of players. In this virtual complex world, players represent individuals, groups, nation states to include terrorist/criminal organizations. Gaming conditions constantly shift based on player decisions. Decisions are required in the realms of sociology, governance, economics and resources, science, technology and engineering, military developments, and others. The game is more than kinetics; it includes military conflict as well as natural resource depletion, starvation, scientific superiority, civil unrest and wealth disparity. In sum, the game is about broad competition across a number of realms.

The intelligence community is also exploring Forterra's On-Line Interactive Virtual Environment (OLIVE) technology platform. Forterra is developing an operational system through which intelligence analysts can come together to test out and prove their hypotheses about current and emerging threats. The system will bring together experts and cultural/social figures from all over the world to participate and role play in an on-line system to determine the validity of a wide variety of scenarios. Analysts will be able to visualize threats and play them out in the virtual world in order to conduct better analysis and ensure multiple threats are considered and acted upon.

Protean Media: A Gaming Approach that Examines Complex Adaptive Systems

In 2001 the Proteus consortium sponsored the development of an educational role playing simulation that allows participants and players to examine the results of human action, interaction and subsequent reactions, convergence divergence, conflict and agreement within a complex adaptive environment. Entity players have the ability within the context of strategic or operational events or series of actions (currently contemporary Iraq is modeled) to establish goals and develop their own strategies to pursue them. Strategies can be revealed or hidden to achieve these goals and players can implement each one in adjustable real time.

Professor John Hiles a computer scientist and career gaming expert, at the Naval Post Graduate School's (NPS) Modeling, Virtual Environments, and Simulation (MOVES) Institute developed the Proteus Media RPS and Critical Thinking Game. It is a "light" and low cost RPS, designed to model shocked or stressed complex and adaptive systems and naturally evolving events. Its tools' characteristics are: composite, connecting and a moving generation system. In the Game, participants face ambiguous complexity manifested by others' goals, strategies and intent. Professor Hiles' goal is "reification" or turning abstract concepts into tangible objects to handle and manipulate. This Game is a systems approach to human conflict. The speed at which this interaction (virtual and cognitive) is played has been radically increased by infor-



mation technologies within the game. The Game contains tables of modeled behaviors and shows the interaction of many models. Play results are paradoxical in nature and render valuable insights about the cognitive domain

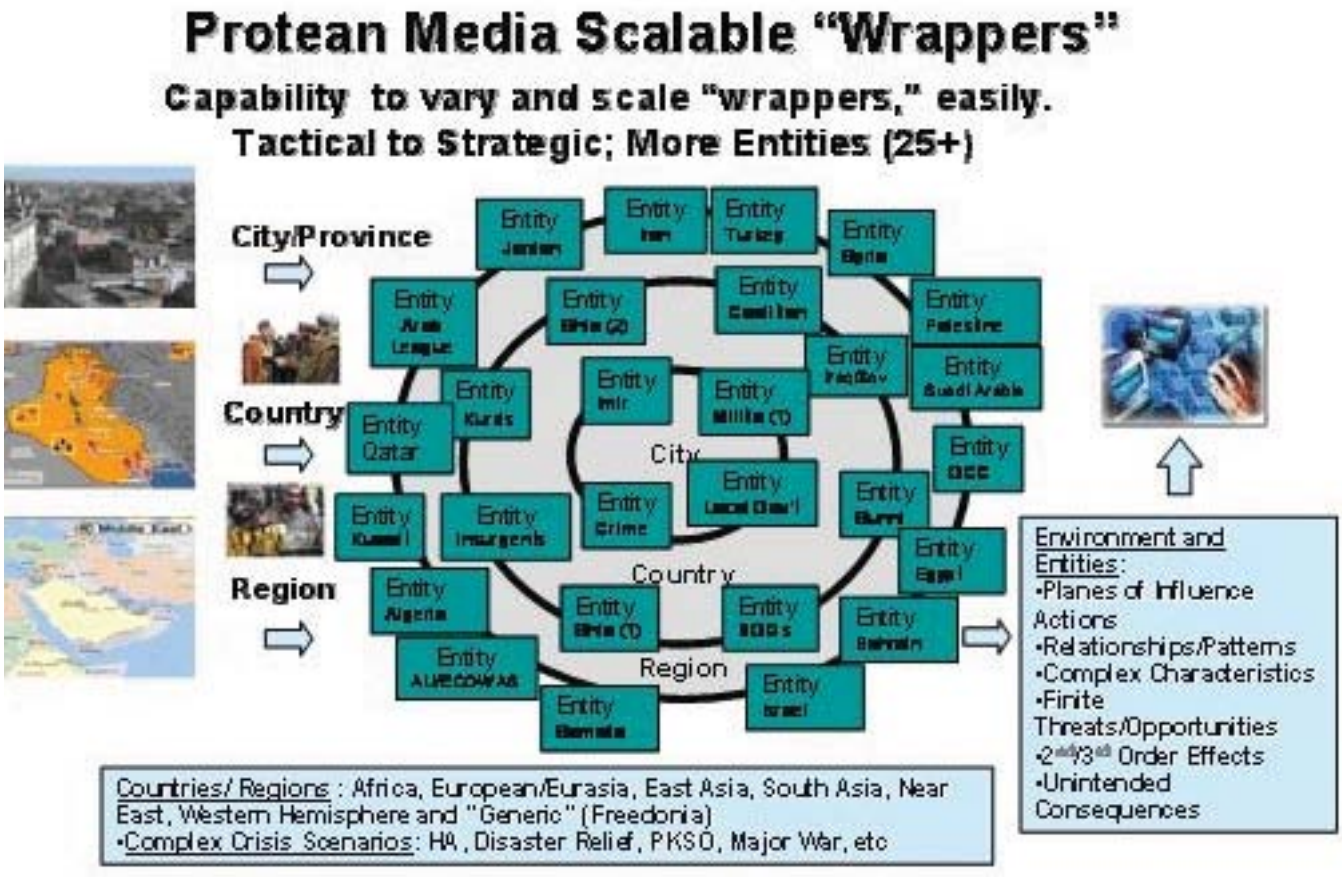
The Game demonstrates complexity by taking tacit entity knowledge, harnessing it and letting it manifest itself as tumbling reality. Inputs and direct or indirect actions will often not produce anticipated or expected results nor will the outcomes be readily mapped into a pattern or even consistently repeated based on the volatile, continually change and temporal nature of human relationships and interactions among entities and populations.

The game environment, entities/groups/factions and their attributes are "wrappers" and can be changed depending on the groups or regional areas where conflict or significant events are played out (disaster relief, humanitarian assistance, regional peacekeeping, stability & reconstruction, civil war, etc). The game as currently configured replicates the factions/groups within Iraq and is modeled accordingly. The game is oriented around thought, interplay and reality. The game supports thirteen possible entity player actions (hard to soft and persuasive to coercive) plus a meeting/negotiations capability. Each action has a suite of modifiers. The key objective of the game is to find where factions and entities, ideas and actions converge and either conflict or agree to gain additional insight on how to reestablish provisional order.

Another game objective is to directly expose players to intended/unintended consequences generated by the indirect or actions and decisions of the various entities. The information is captured in the data and by incorporating a thorough After Action Review process, and collecting outputs, these inferences can be turned into lessons learned supported by the game data as a result of the play.

Protean Media Physical Gaming Requirements

The software is not proprietary and is U.S. Government owned. The Protean Media game is Microsoft based and has limited graphics making it portable and usable on almost any government laptop or desktop computer. Actual



hardware system requirements are minimal for client and server systems. The client server machine should be at least a Pentium 4 with 512 MD RAM and Windows XP. It can handle up to 25 clients as currently configured. As game software and data are enhanced or additional clients are added, it may require additional memory and processing speeds. The network configuration is also relatively simple and versatile. It can be run on a non-secure or secure LAN or wireless network. It also can be web-based and played over the internet.

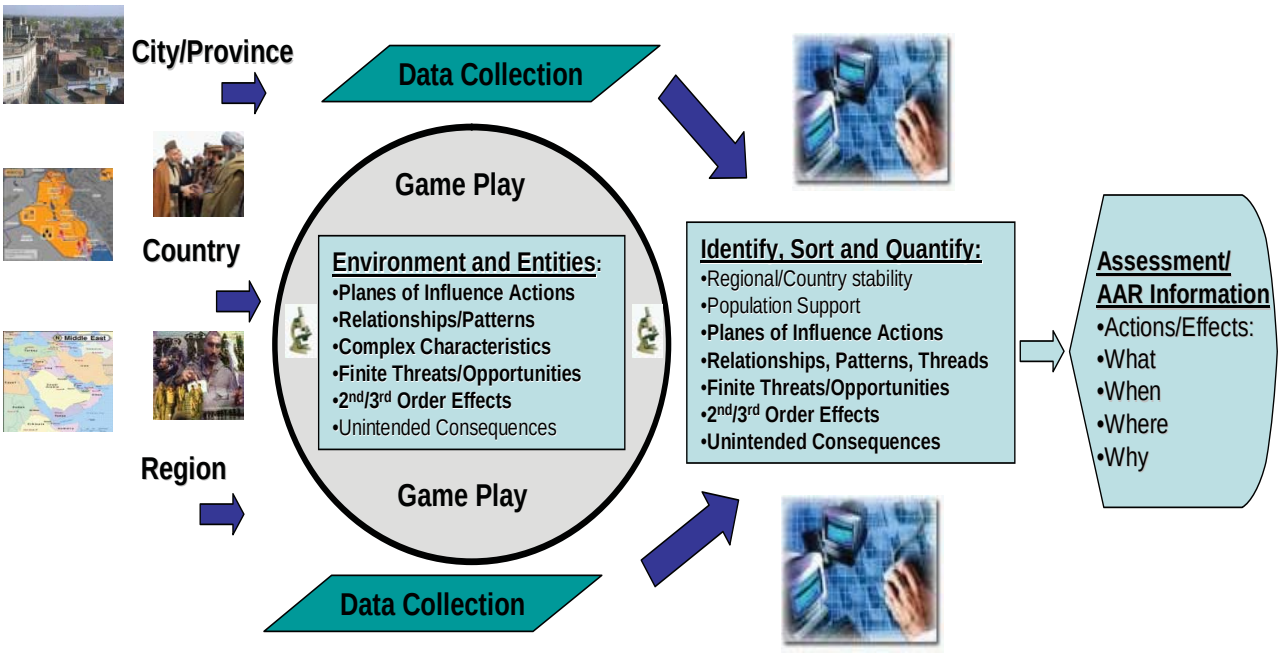
Protean Media's Future Potential

The current Game's basic backbone architecture has great growth potential to optimize play, and educational benefit, not only within the military but the government as well. The Game needs to be reconfigurable and up graded to model/replicate additional scenarios, entities and multiple planes of complexity. It can add more than 25 entities/players/actors at minimal cost with only minor design modifications. Additional enhancements to the game should be designed not only to look at cognitive interaction and convergence but to better understand the results of unintended/intended outcomes or second and third order effects. Although the Game has a closed versus an open architecture, it still is relatively easy to develop a series of different "wrappers," tactical to strategic, within different countries and regions that can be applied to most real world or future scenarios using the basic architecture currently on hand. Currently the NPS MOVES Institute is examining the use of artificial Intelligence or smart agents to play Game entities in future versions.

The Game, which is currently configured as an educational tool to reinforce student experiential learning, can also be redesigned as a decision support tool (expert agent planning or a rehearsal vehicle, or outcome model) for future experimentation and wargaming. If used in this venue, the validity of outcomes should be based on decisions and actions of experts, using the many attributes particular to an actor/group/entity. The latter configuration will take significant effort and major work to do adequately; however, it is feasible. Lastly, to improve feedback and to facilitate data collection and analysis,

Protean Media Data Collection and Analysis

Improved Analytical Function for player or assessor review



the game needs a process to gather, sort and parse key information about entity actions, relationships and resultant reactions and second and third order effects.

Summary

Although there has been little emphasis on the use of Serious Gaming within the JIIM community in the past, the PMG effort and others are significant first steps to begin capitalizing on a largely untapped capability to supplement the current L-V-C simulations discussed above in order to more effectively conduct experimentation and intelligence analysis, test strategy and educated leaders a every level about the complex environment where they will operate. However, more research and experimentation is needed to convert commercial serious gaming applications to meet and address the gamut of government and military operational and educational requirements.

The Protean Media is not the total panacea for gaming or modeling complexity; however, it provides a foundation for others to build upon. The ultimate goal of the PMG is to develop a scalable variable wrapper, agent based interactive experiential education and planning and implementing tool/game which can capture entity many actions, develop threads and relationships and identify cascading second and third order effects and unintended consequences in complex environments. This will be done by incorporating the complex, temporal and changing effects of human-behavior/belief systems and social/cultural dimensions. The game must continue to integrate advances from gaming theory, belief systems/influence models, perception and cognitive modeling and other complex-nonlinear programming efforts to create the ultimate "paradoxical" game.

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